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Allegheny Portage Railroad

New Support for Old Arches

From 1834 to 1854, a technological workhorse stepped back and forth over the Allegheny Front using 11 levels and 10 inclined planes to connect the Juniata and Western Divisions of the Pennsylvania Main Line Canal. Two railroads and three canal divisions comprised this statewide transportation system which connected Philadelphia and Pittsburgh, ultimately reducing that trip from three weeks by wagon to four days by rail and water. For its part, the Allegheny Portage Railroad hoisted and hauled not only passengers and cargoes but the canal boats themselves to overcome a rise and fall of 2,570 feet.

Allegheny Portage Railroad National Historic Site, a unit of the national park system, was created to preserve and illustrate the history and remains of this, the first railroad to cross the Allegheny Mountains. Although designated a National Engineering Landmark, the park is among the lesser known of National Park Service railroad sites. Models, industrial artifacts, demonstrations, and documentary evidence are obvious devices used to present aspects of constructing, operating, and traveling on the Allegheny Portage Railroad to today's visitors, but the park's best-kept secret is the systematic stabilization of remnants of the line's permanent stone masonry and earthwork now hidden along the reforested right-of-way.

Dismantling process—coping course, culvert 1733.

By hand labor, the mostly immigrant work force grubbed and cleared the 36-mile corridor designated by engineers and surveyors, cut through landforms, and filled gaps. They put together culverts and drains, bridges and viaducts, retaining walls and water supply systems, and blasted through a rock escarpment to open what Appleton Contractors called the first railroad tunnel in America.

For construction purposes, the line was divided into sections varying from 2,600 to 5,900 feet and stations of 100 feet. All levels and inclines were numbered from west to east, but the Johnstown and Hollidaysburg, Long and Short, and Summit Levels also acquired geographically characteristic names. Culverts spanning from 5 to 20 feet were numbered by section and also by station, indicating their distance from the western terminus.

The National Park Service owns the extant top of Incline 1, together with a two-mile segment of the Long Level and most of the Summit Level, together with Incline 6 through the foot of Incline 10. Engine house foundations at the heads of Inclines 1, 6, 8, and 10; 18 original culverts and drains; and one historic tavern are studied and preserved.

The historical data section of the Historic Structure Report for the Allegheny Portage Railroad recommended preservation, stabilization, and rehabilitation of historic structures and foundations. In 1993, the architectural data section described existing conditions. The following

Splitting sandstone slabs for culvert 1656 using feathers and wedges.

year, the Williamsport Preservation Training Center, now the Historic Preservation Training Center (HPTC), began emergency stabilization work on two culverts. In 1995, a task directive was approved for the phased preservation and stabilization of various culverts. Since then, a priority order of culverts endangered by time, the elements, re-vegetation, and re-engineering has been established and preservation treatment is underway.

Training goals for these projects range from preparation of condition assessments and treatment recommendations for a historic stone structure to documenting and disassembling the structure (identifying, documenting, and tagging the stones), constructing cut stone arches and relaying and repointing stones in the original positions.

To appreciate the scope of the work, one must understand the character of an arch. An arch is a structure built to support the weight above an opening. It consists of wedge-shaped stones or bricks called voussoirs put together to make a curved bridge which spans the opening. The keystone, the central locking stone, bears the weight of the stones pressing down from above. The pressure from above in turn pushes on the stones next to the keystone on both sides. This pressure, or thrust, is relayed from stone to stone down both sides of the arch until it reaches the bottom blocks, called springers, and then is carried down the piers to their foundation and into the ground. If the arch is too long or if the piers at the ends are too light, the outward thrust will push the sides out and the top will cave in. If the arch is too light at the top, or too heavy at the sides, the sideward thrust of the arch will push the top up, and the sides will cave in. When supporting its own weight and the weight of crossing traffic, every part of the arch is under compression. Several of the remaining culverts of the Allegheny Portage have supported the weight of many tons of earth fill and the weight of not only the traffic they were built to carry but of additional fill and traffic of the Pennsylvania Railroad (PRR) where that company's line coincided with the historic alignment.

Constructing an arch is tricky since the structure is completely unstable until the two spans meet in the middle. One technique is to build elaborate scaffolding, called centering, below the spans to support them until they meet. Stonemasons start at the bottom of the arch and place voussoirs on the centering. The centering supports the voussoirs until the keystone is inserted.

Mortar is generally used in building an arch, with more than one type and more than one way to apply it. Modern builders use a variety of techniques, generally having a joint 10 millimeters thick. With the lime/water mix common historically, the joint can be as fine as 1.5 millimeters. The trouble with this traditional mix is that the lime is soluble in water and does not adhere strongly to the stone. In time, the jointing material may perish and the block may slip out of position.

The first duty in working with the culverts is to reveal the arch itself. Trees and other vegetation tend to grow over the historic fabric, both obscuring it and doing actual damage. Overburdening loads are concerns at culverts, as are erosion and weathering.

The culvert at station distance 1656 offers a successful case study. Its inlet had been buried by erosion decades ago and slope drainage was cutting a new channel across the historic trace. The inlet was located by tracing it through the outlet ruin and the mostly intact barrel vault. Removal of the alluvial overburden in 1996 revealed the inlet with 50 percent of its face stones intact. Reconstruction of the missing features was determined to be a worthwhile effort and that work was undertaken in 1997.

Stone for the reconstruction was obtained from the Briar Hill Quarry of Glenmont, Ohio because it is working stone from the same geologic formation as is found at the Portage Railroad. Freshly quarried stone is preferred

because its performance in cutting and shaping is more predictable than recovered or re-used stone. Stone came from the quarry in large slabs of thickness defined by the existing coursing of the culvert wall. Weighing over 1,200 pounds, these slabs were five to six feet long, 22 to 36 inches wide, and 11, 13, and 15 inches thick. From the slabs, stones of random lengths were cut and faced using traditional hand tool methods.

A short assignment of using traditional feather and wedge tools to cut the large slabs into individual stones demonstrated to the HPTC crew the labor-intensive and often frustrating methods their 19th-century counterparts likely used. For the most part, however, the stones were cut using a gas powered masonry saw outfitted with a dry cut diamond blade, then split using wedges from the feather and wedge sets.

Stonemason Rene Laya was the instructor, demonstrating and reviewing masonry methods for the HPTC crew. Various size handsets, bull points, toothing chisels, and tracers were used to dress the new stone. In two and a half days, three masons dressed approximately 30 linear feet of 11-inch-thick stone blocks with both curved and straight faces.

To speed production, the crew switched to pneumatic stone carving tools that would still replicate historic textures. Use of a four-point brush chisel and a machine point was an acceptable alternative to a hand point method.

Instead of the wooden stone sleds the portage workers used to move rock, the HPTC crew used cranes and a skidsteer loader. The stones were cut at the park maintenance area, loaded onto a stake body truck and taken to the culvert. Cranes and a loader offloaded the truck and helped to place the stones into culvert 1656.

Dismantled culvert—backer wall exposed, culvert 1733.

A centering constructed of three three-quarter-inch thick plywood ribs was cut to match the radius of the arch. The three ribs were connected by a pair of two-by-fours laid flat to act as bearing points for four bottle jacks that supported the centering once it was set. Bottle jacks allowed adjustments to fine-tune the plumb and level position of the centering and allowed for the centering to be easily removed after the work was complete.

Mortar was used in the re-assembly of 1656. The mixture chosen was one part gray Portland cement, one part hydrated lime, and six parts C144 masonry sand. Archeology on the Portage remains suggested that some stone work was laid with little or no mortar, while other contractors chose to use their favorite mixture of adhesive. With the culvert's historic function of routing water under the railroad trace restored, conservators decided that the use of mortar would improve maintainability.

Once the voussoirs and keystone were in place, the related backfill and drainage concerns addressed, and the mortar set, the centering was removed. The inlet area was regraded and seeded and the continued functioning of 1656 ensured.

A considerable amount of work went into the building of the Allegheny Portage Railroad; preservation of its features often requires a similar kind of persistence. Using a combination of historic and modern tools and construction methods, today's conservators can safely and efficiently match the fabric of historic masonry while strengthening and repairing the historic structure.

Additional benefits in the form of interpretive material accrue with each repair. Project-related research has the potential to add to what is known about the people associated with the line and with industries, commercial ventures, and communities affected by the line.

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Photos by NPS Historic Preservation Training Center, 1996. Courtesy Allegheny Portage Railroad National Historic Site.